Influence of TOPEX/POSEIDON Sea Surface Height Measurements on NCEP Simulations of Tropical Pacific Upper-Ocean Currents

D. Halpern
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, CA 91109

D. Behringer, M. Ji, A. Leetmaa, and R. Reynolds
National Centers for Environmental Prediction
National Oceanic and Atmospheric Administration,
Camp Springs, MD 20746

A numerical experiment to quantify the impact of TOPEX/POSEIDON (TP) data on U.S. National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Prediction (NCEP) simulations of monthly-mean upper-ocean currents in the tropical Pacific is described. NCEP simulated currents were computed with assimilation of subsurface temperatures and TP data and, also, were computed with assimilation of only subsurface temperatures, which are, respectively, named "currents simulated with and without TP". The time interval is January 1993-December 1996. The discussion will focus on the east-west current component at 5- and 15-m depths between 20°S and 20°N and the zonal current component along the equator and above 250 m. Longitudinal dimension is 140°E-80°W. The measure of significance between monthly-mean currents simulated with and without TP data is arbitrarily defined to be 5 cm s^{-1}, which is easily detected by in-situ current-measuring instruments.

At 5- and 15-m depths, the 4-year mean zonal currents simulated with and without TP contained the usual features: South Equatorial Current (SEC), North Equatorial Countercurrent (NECC), and North Equatorial Current (NEC). Along 150°W ("NORPAX Line"), maximum speeds in the SEC, NECC and NEC were about -37, 12, and -22 cm s^{-1}, respectively. The 4-year bias was less than 5 cm s^{-1} throughout the NEC, nor was it significant in the NECC and SEC east of the dateline, except for a small region in the SEC near 0°, 125°W. The maximum bias (10 cm s^{-1}) occurred near 0°, 150°E. The annual cycle will be discussed. At 5 and 15 m, differences of grip-point standard deviations of the currents simulated with and without TP were everywhere less than 5 cm s^{-1}. At 5 and 15 m, the grid-point root-mean-square (rms) differences between the two simulations were greater than 5 cm s^{-1} between 5°S and 15°N, where centers of maximum and relative-maximum values occurred along the equator at 150°E, 155°W and 110°W. Accuracy of simulated 5- and 15-m currents will be evaluated with satellite-tracked drifter buoy measurements.

In the 0.5°S-0.5°N equatorial zone from 5-250 m and 140°E-80°W, the 4-year zonal currents simulated with and without TP displayed the usual features: SEC above 50 m, and Equatorial Undercurrent (EUC) with maximum speed of about 100 cm s^{-1} located near 125°W. The 4-year mean bias had an interesting longitudinal-depth pattern, with currents simulated with TP were less than currents computed without TP everywhere east of the dateline and vice versa west of the date line. Biases were significant east of 130°W and west of 175°E. The annual cycle will be discussed. Differences of grid-point standard deviations of currents simulated with and without TP were greater than 5 cm s^{-1} over 75% of the longitude-depth section. Grid-point rms differences between the two simulations were everywhere greater than 5 cm s^{-1}. For both simulations, the longitudinal patterns of the 4-year mean EUC core speed were very similar, with a maximum bias of 10 cm s^{-1}. For longitudes between 160°E and 95°W, the 4-year mean depths of the EUC core speed differed by less than 10 m. For longitudes between 160°E and 95°W, the SEC transport per unit width was almost the same for both simulations.

Accuracy of equatorial currents simulated with and without TP was evaluated at four longitudes (165°E, 170°W, 140°W, 110°W) where moored acoustic Doppler current profiler

(ADCP) measurements had been recorded. Standard deviations of monthly-mean EUC core speeds simulated with and without TP were less than 5 cm s^{-1} of that computed with ADCP data, except at 165°E for the simulation made with TP and at 140°W for the simulation made without TP. RMS differences were computed between monthly mean EUC core speeds estimated from ADCP data and from each simulation. Only at 110°W was the difference between the two rms difference values greater than 5 cm s^{-1} where assimilation of TP data increased the rms difference by about 8 cm s^{-1} or 30%. Further evaluations of the representativeness of equatorial currents simulated with and without TP will be made with shipboard ADCP measurements.

These and additional results, including attributes of the meridional current component, eddy kinetic energy and the annual cycle, will be discussed.